18 November 2006

Measurement of fibers attenuation length. Update on the work in progress in Italy

N. Moggi, M. Mussini, S. Zucchelli , C. Crescentini and A. Margotti - INFN Bologna

W. Baldini, E. Luppi, M. Cenci and V. Carassiti - INFN Ferrara

In Ferrara:

Improved the apparatus : a longer fiber support 1.4 m instead of 1 m

Measured 32 meters long fibers in order to do comparison with shorter lenght measurement

Increased knowledge of the sistematics in the measurements, still some misteries

In Bologna:

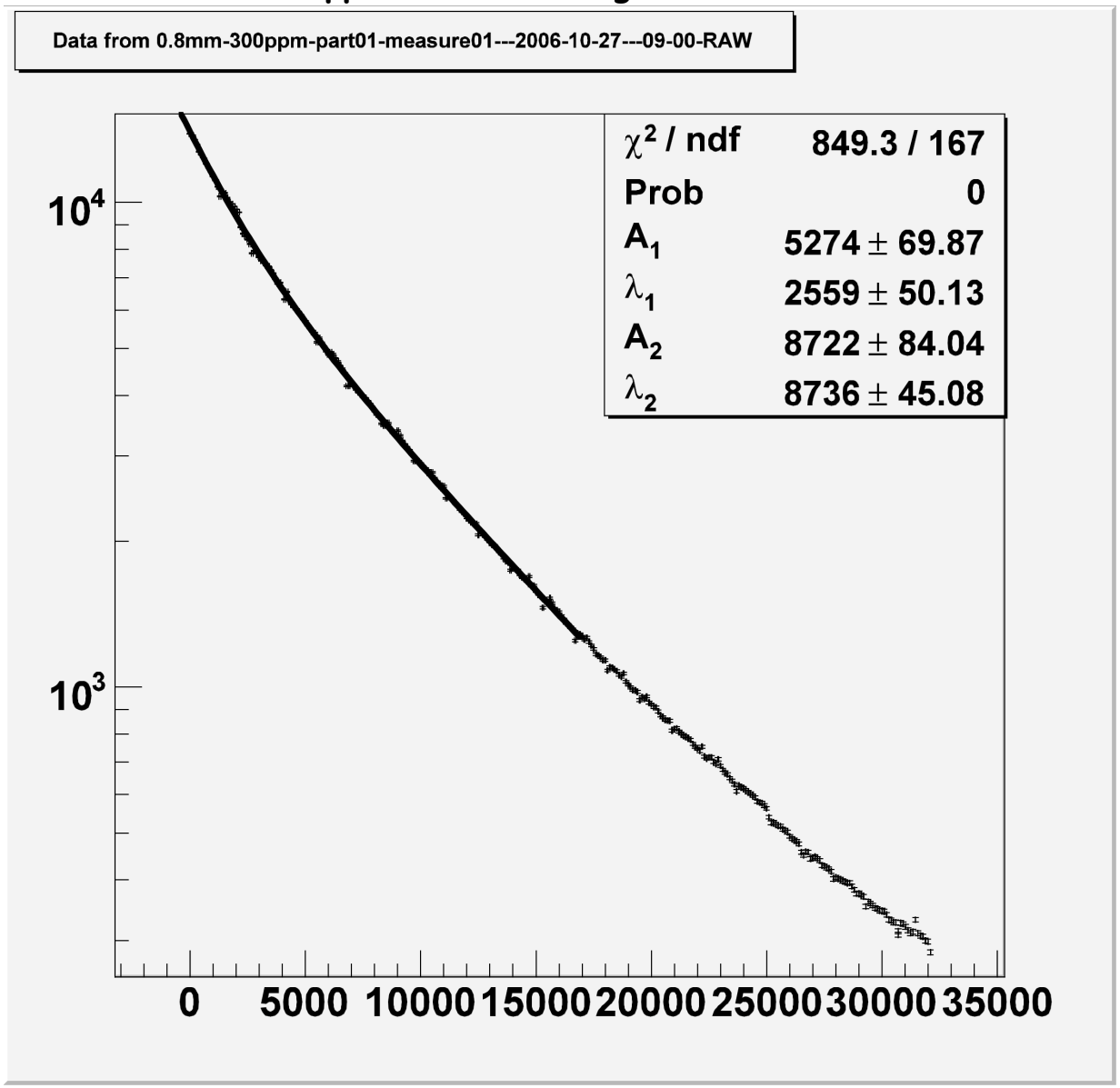
Found some lab. space : almost ready for aging tests since

we got 20 liter of pseudocumene from Borexino , but only a week ago and

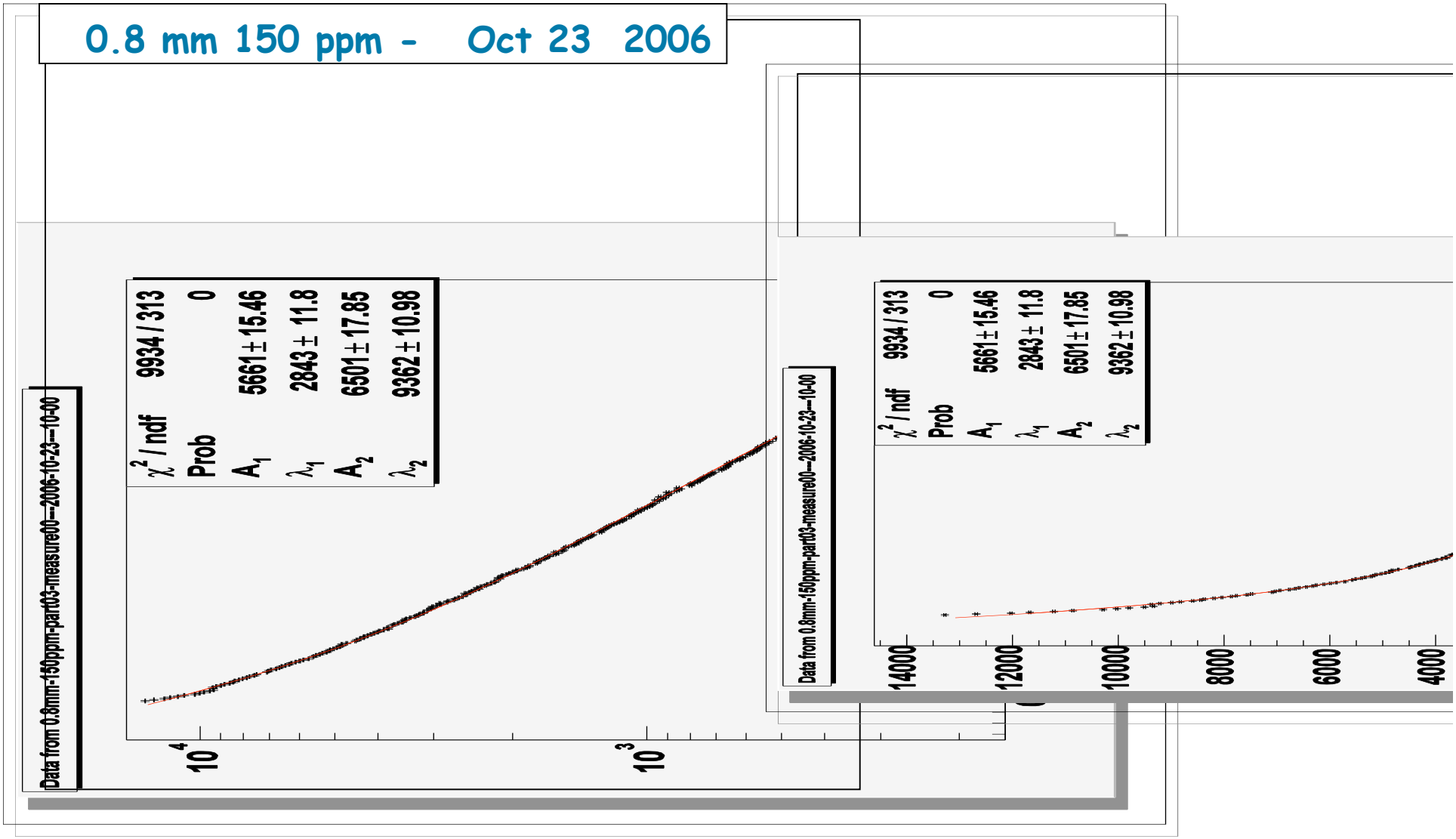
we bought two APD S8864-20K form Hamamatsu, ordered on September 21, 2006 .but not yet delivered

In CNR : start measurement with laser illuminating a fiber set inside a PVC extrusion

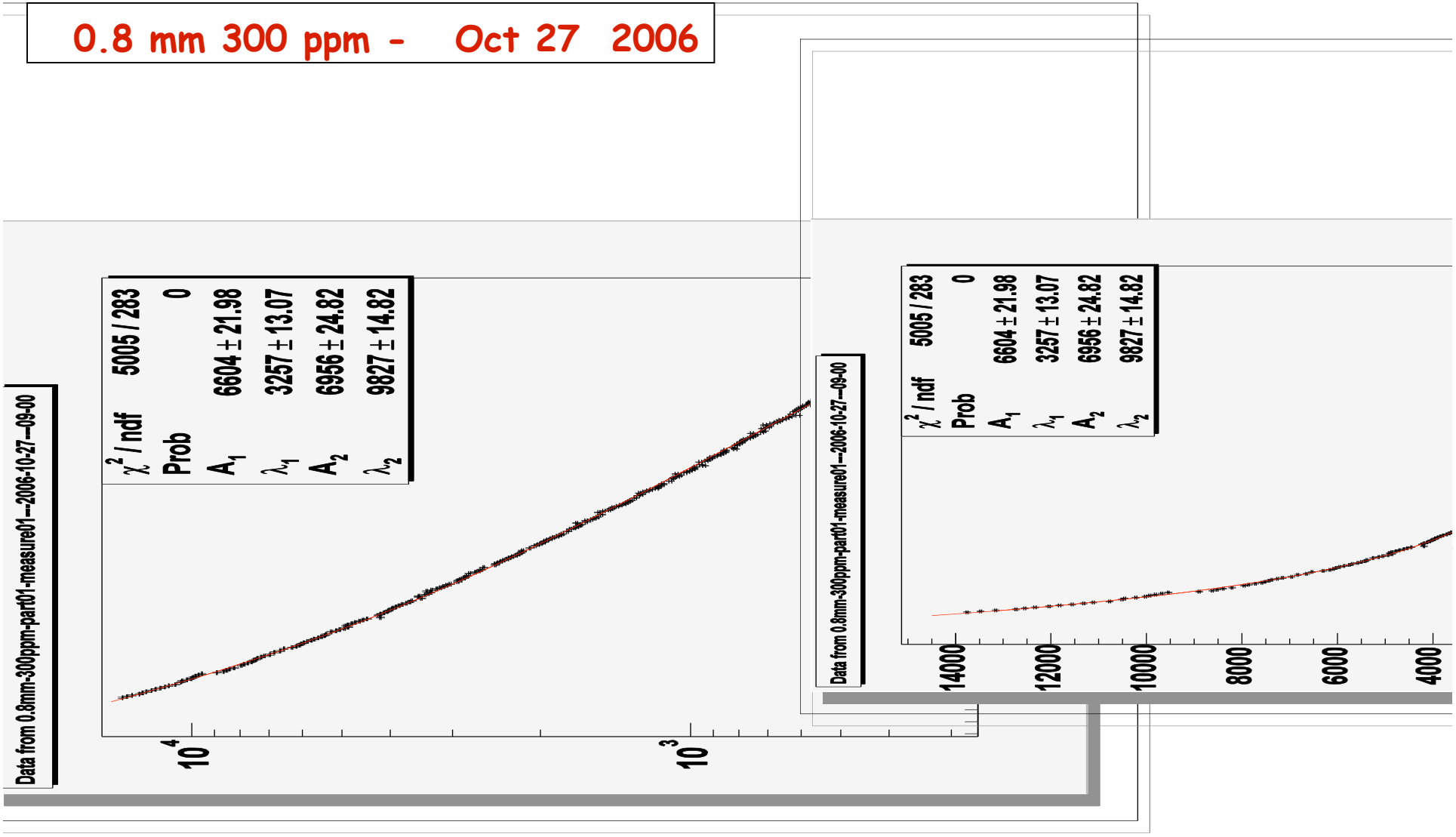
Raw data for 0.8 mm 150 ppm 32 meter long fiber



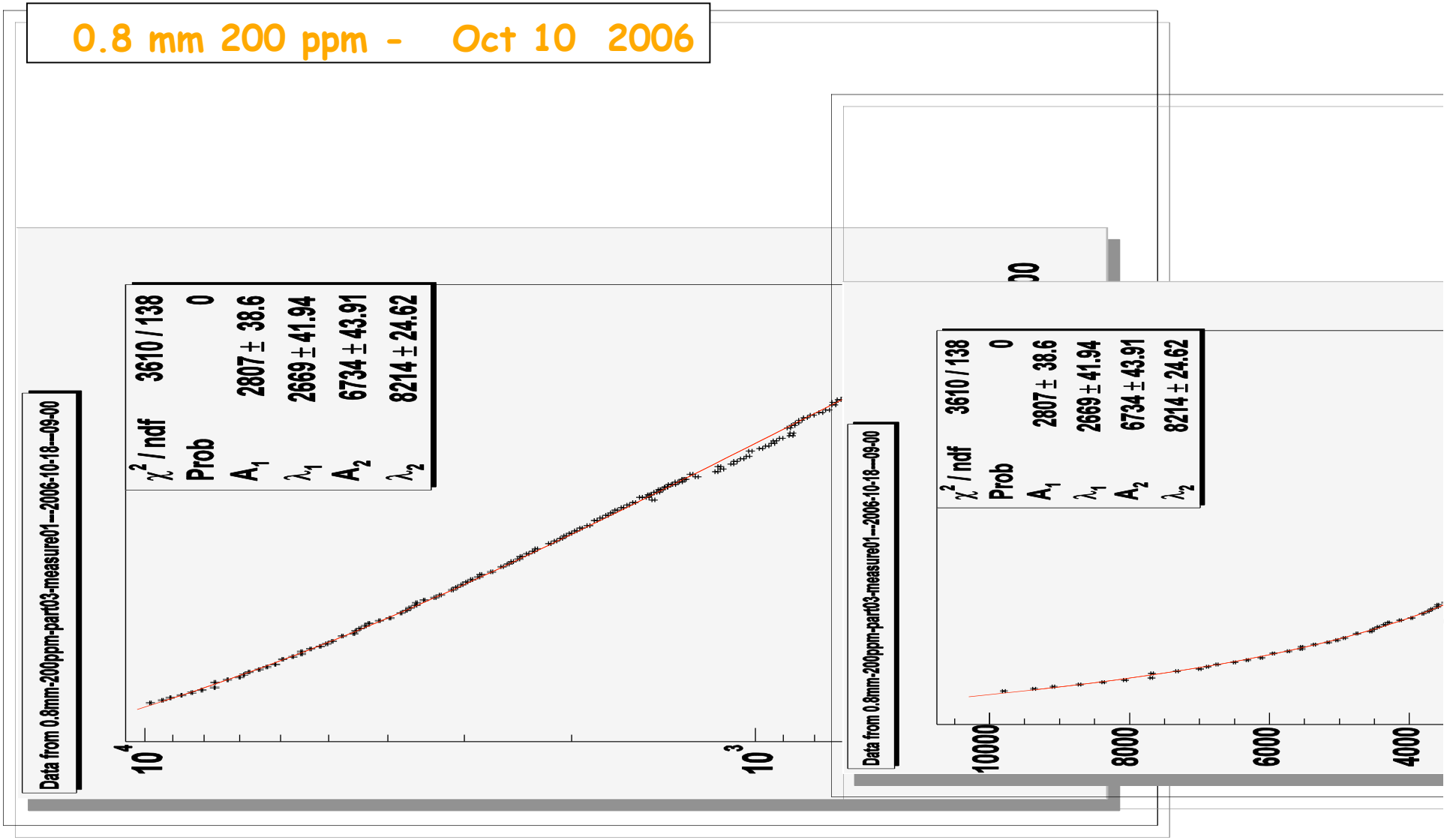
Measurement of fibers 32 meters long in the upgraded apparatus



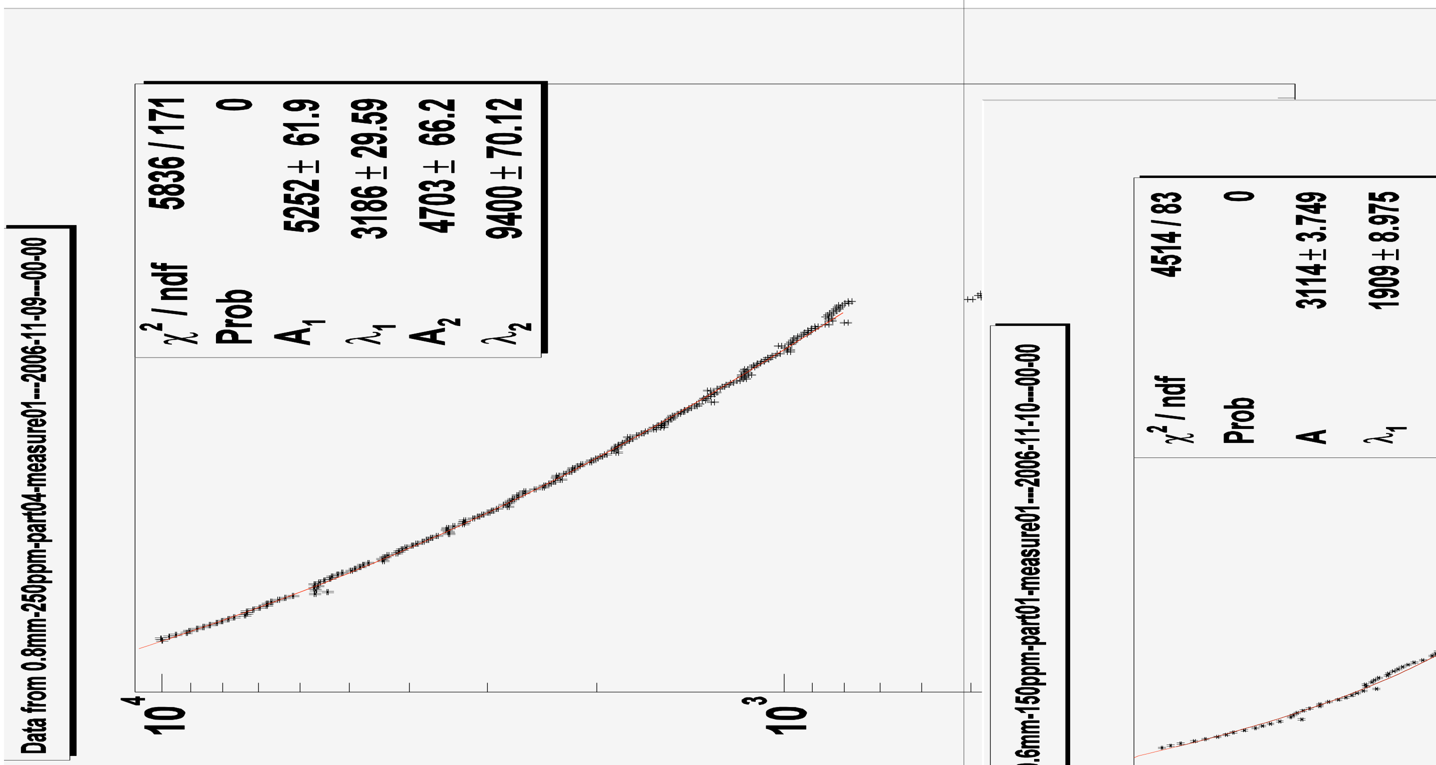
0.8 mm 300 ppm - Oct 27 2006



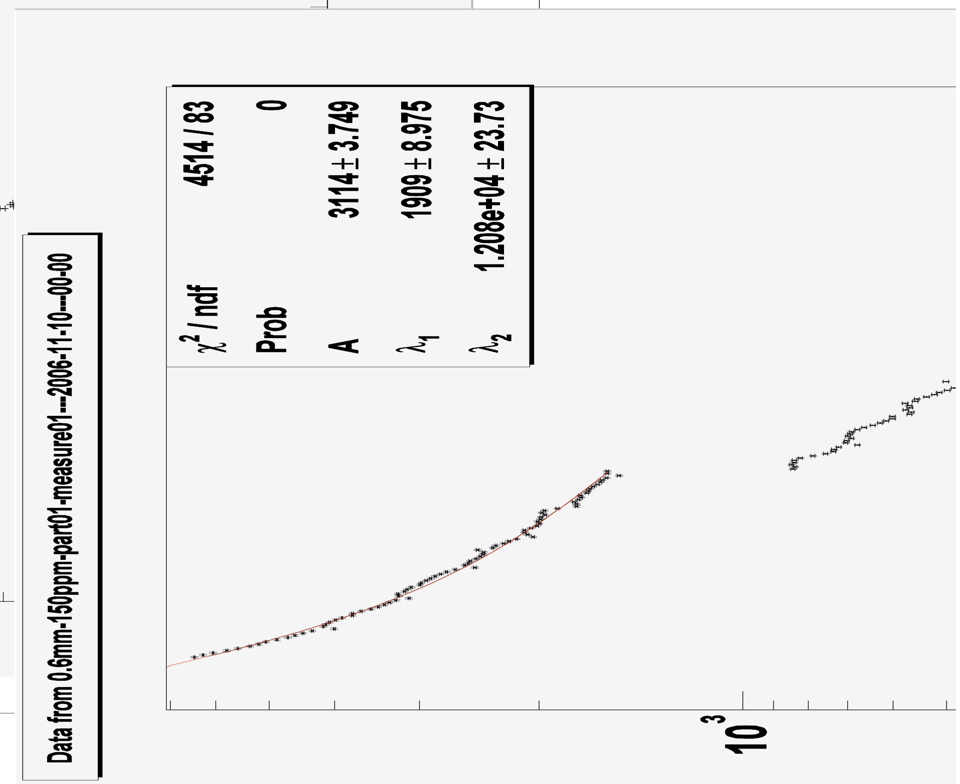
0.8 mm 200 ppm - Oct 10 2006



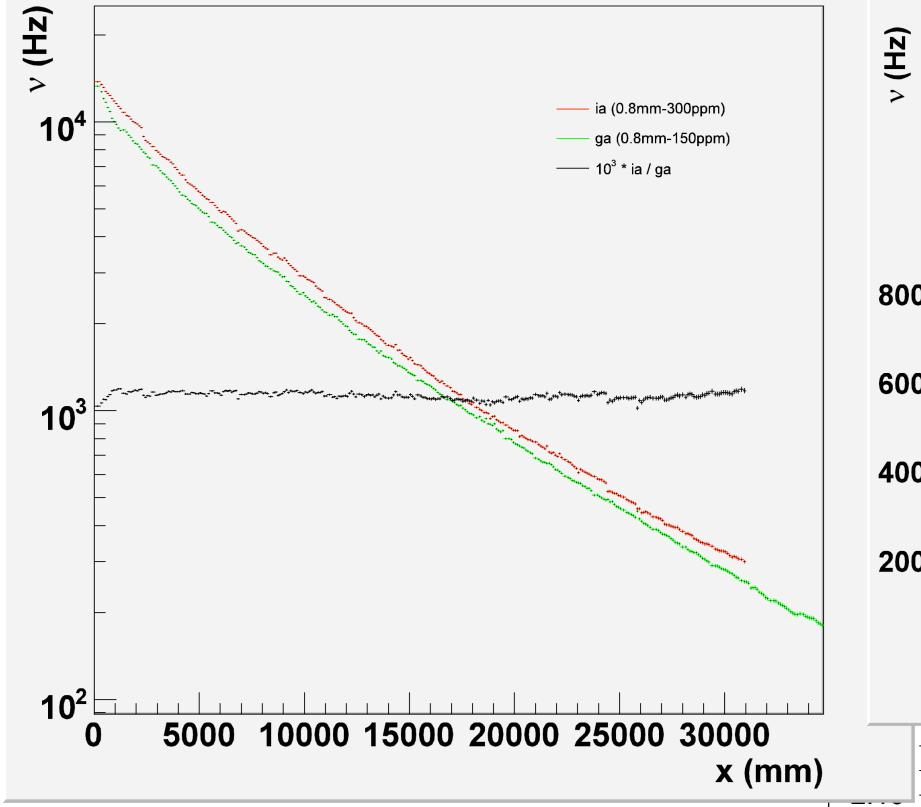
0.8 mm 250 ppm - Nov 9 2006

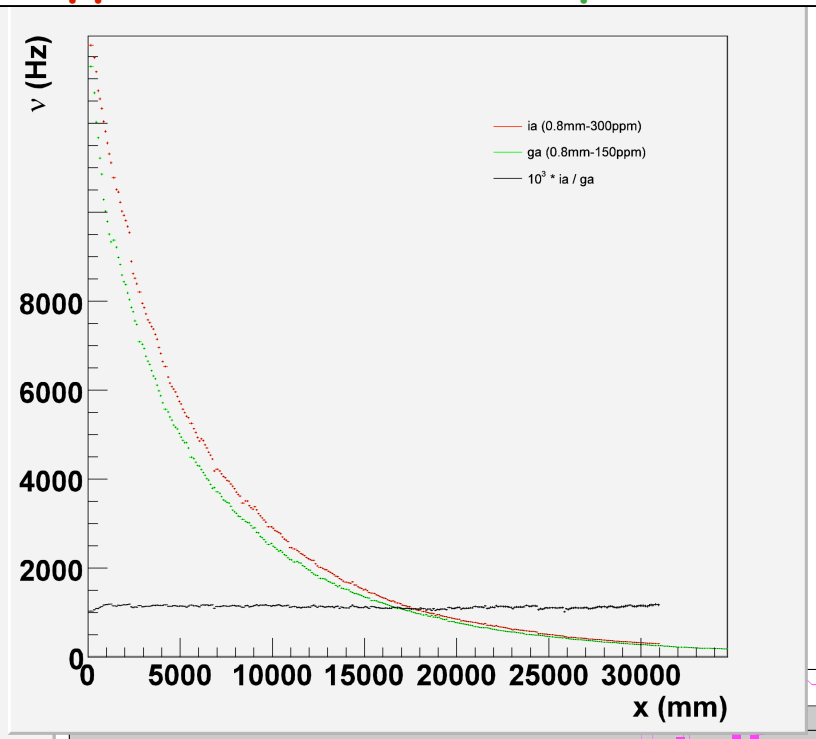


0.6 mm 150 ppm - Nov 10 2006

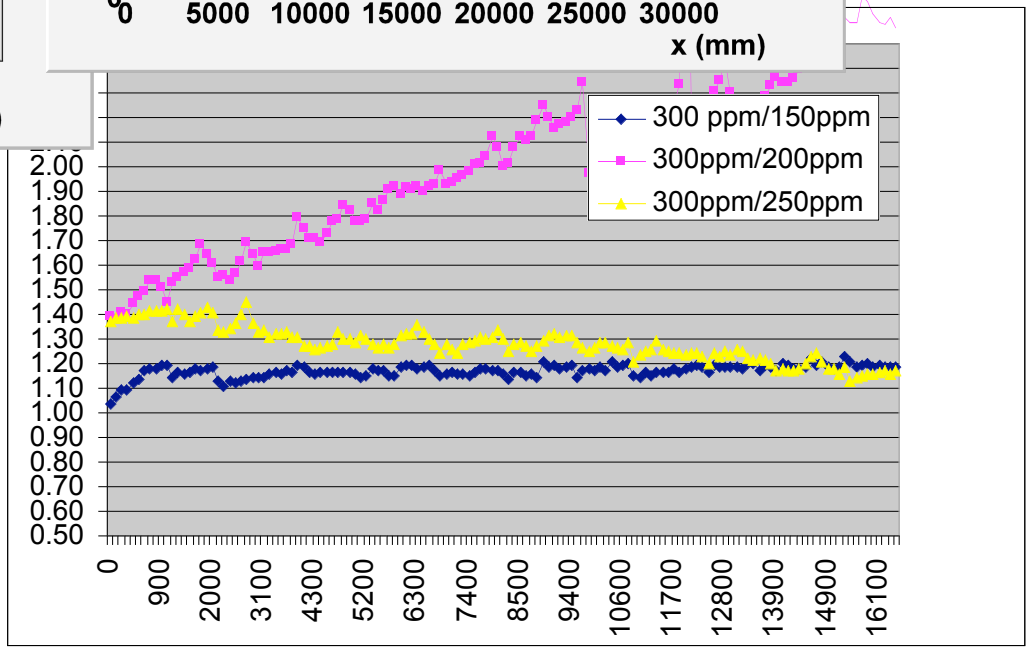


Ratio of RAW Data of 0.8 mm 300 ppm over 0.8mm 150pmm Nov 15 2006





Ratio of RAW Data
from 0 to 17 meters

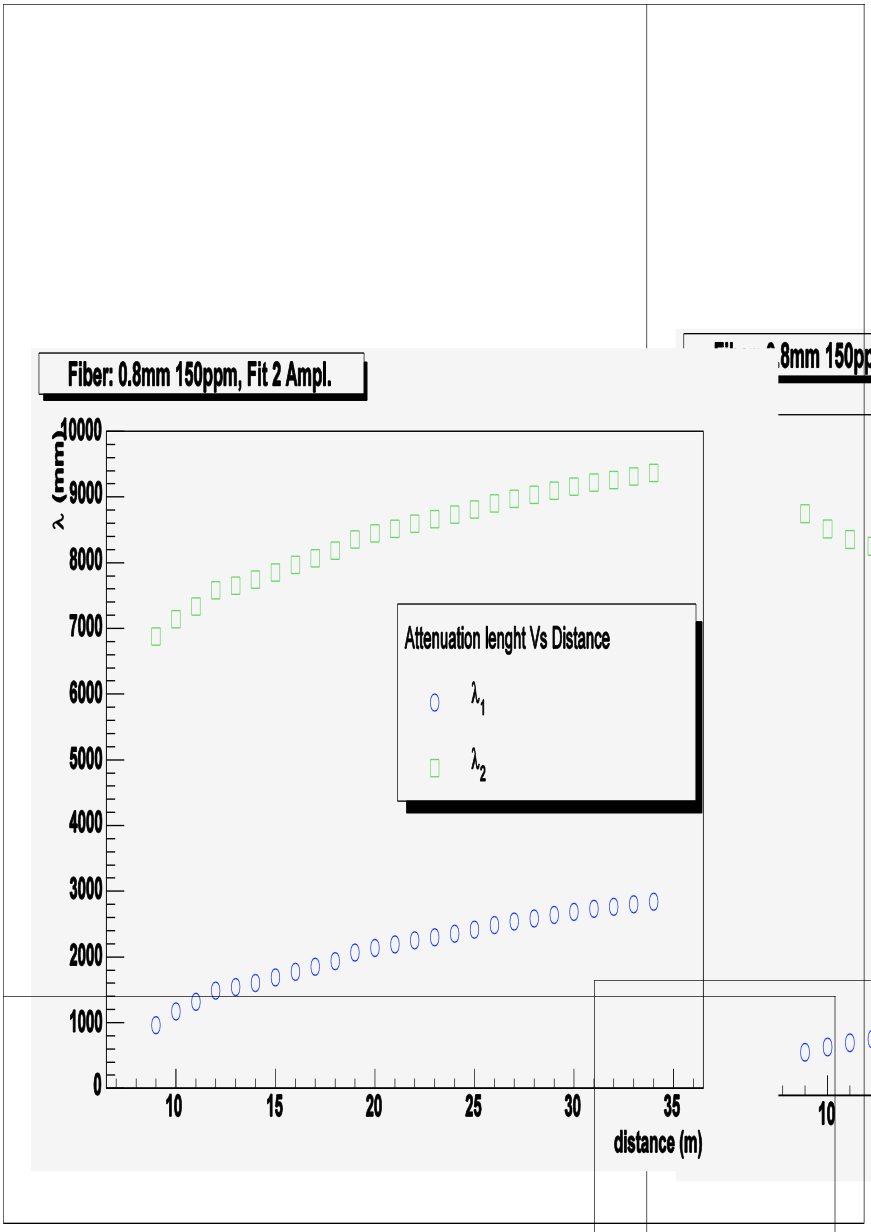


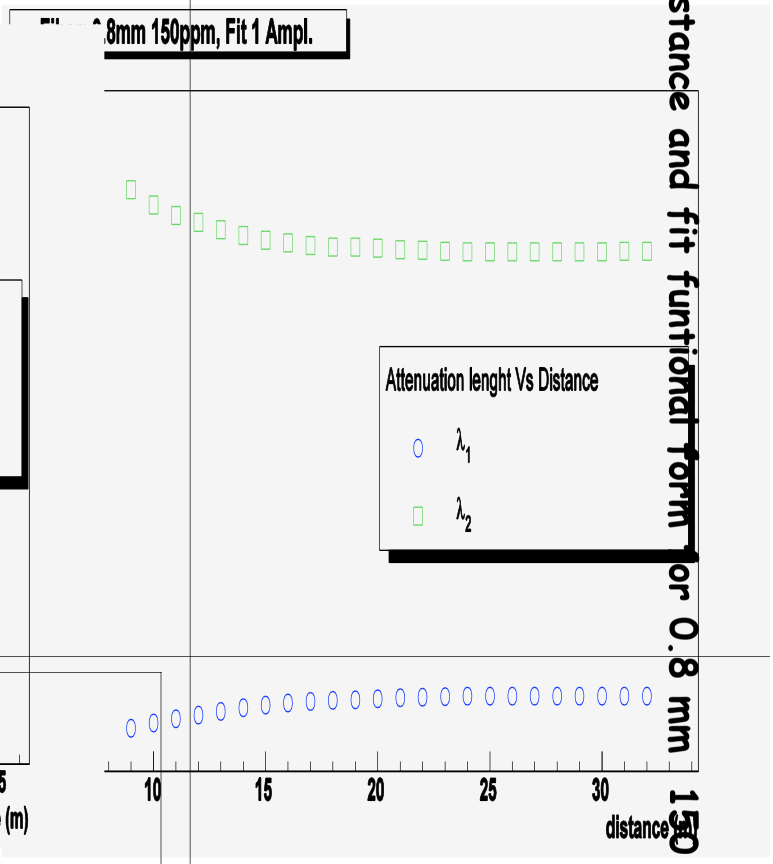
We measured 32 meter long fibers and we also have short samples of fiber measurements so we have now a set of measurements done at quite different fiber length.
Question :

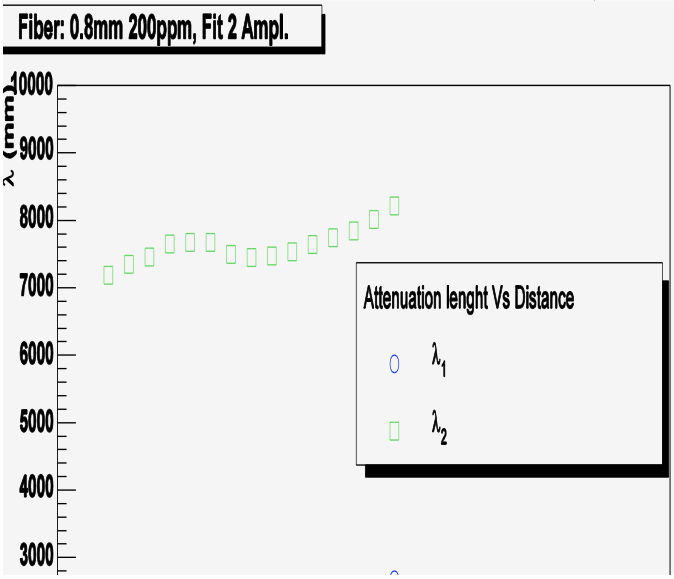
- is there a difference in the results as function of the fiber lenght ?
- is there a difference between single and double amplitude fit ?

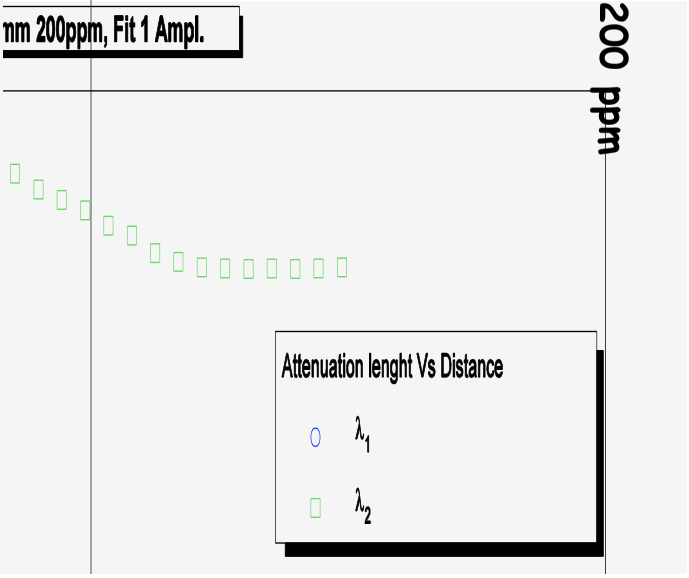
Under the assumption that fitting a long fiber in a shoter range is equivalent to fitting a really shorter fiber …

Lambas vs distance and fit funtional form for 0.8 mm 150 and 0.8 200 ppm

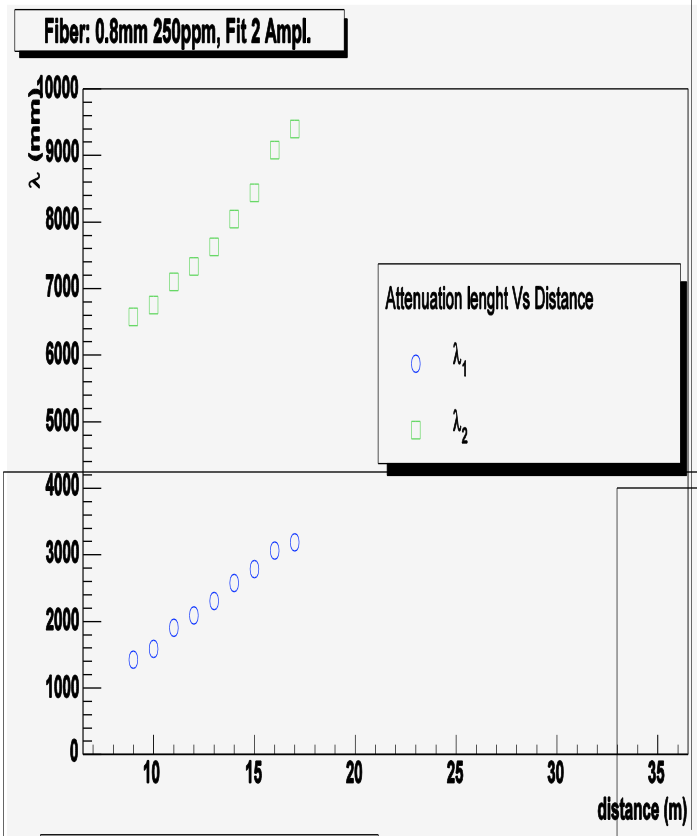


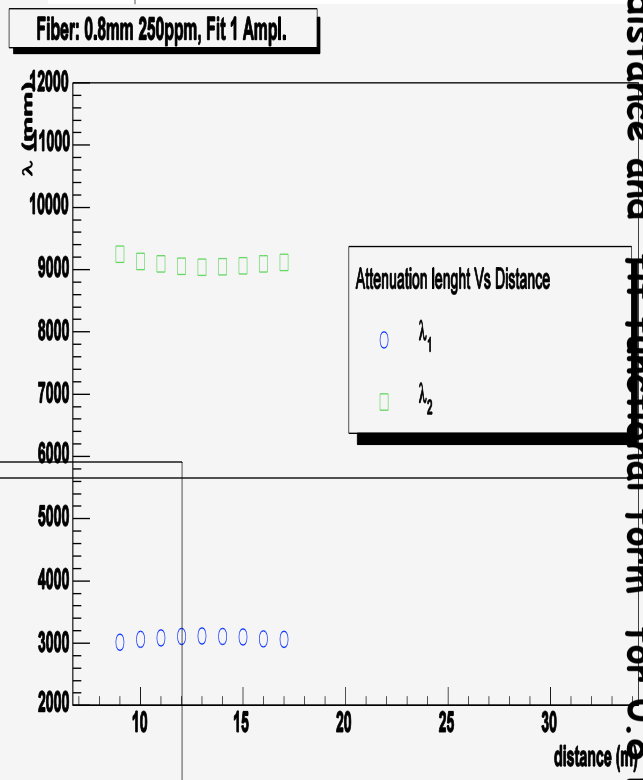


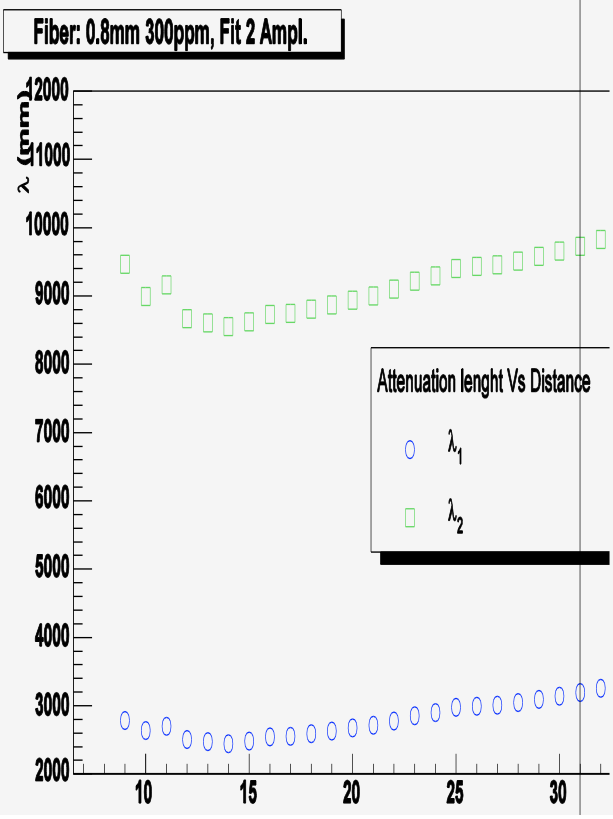


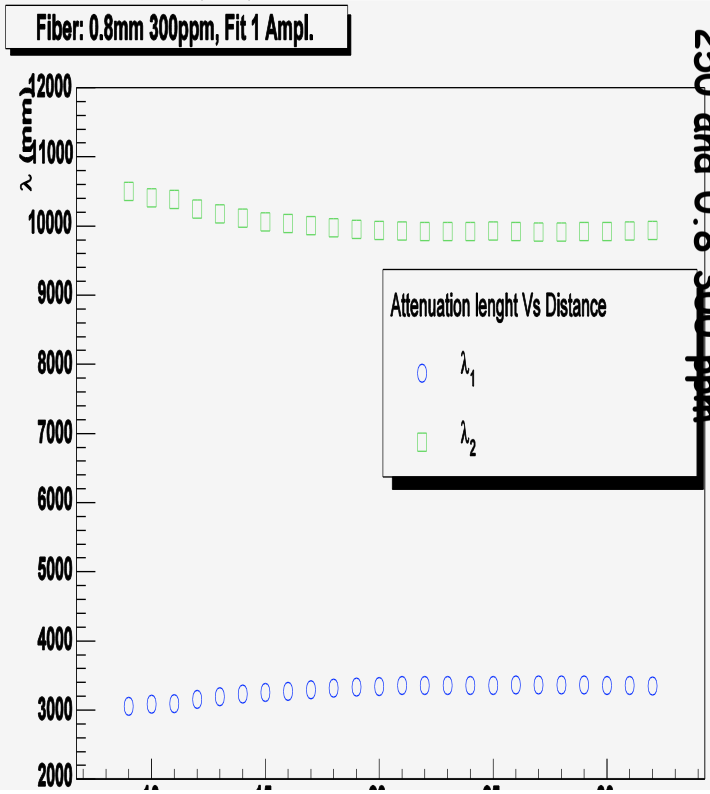


Lambas vs distance and fit functional form for 0.8 mm 250 and 0.8 300 ppm

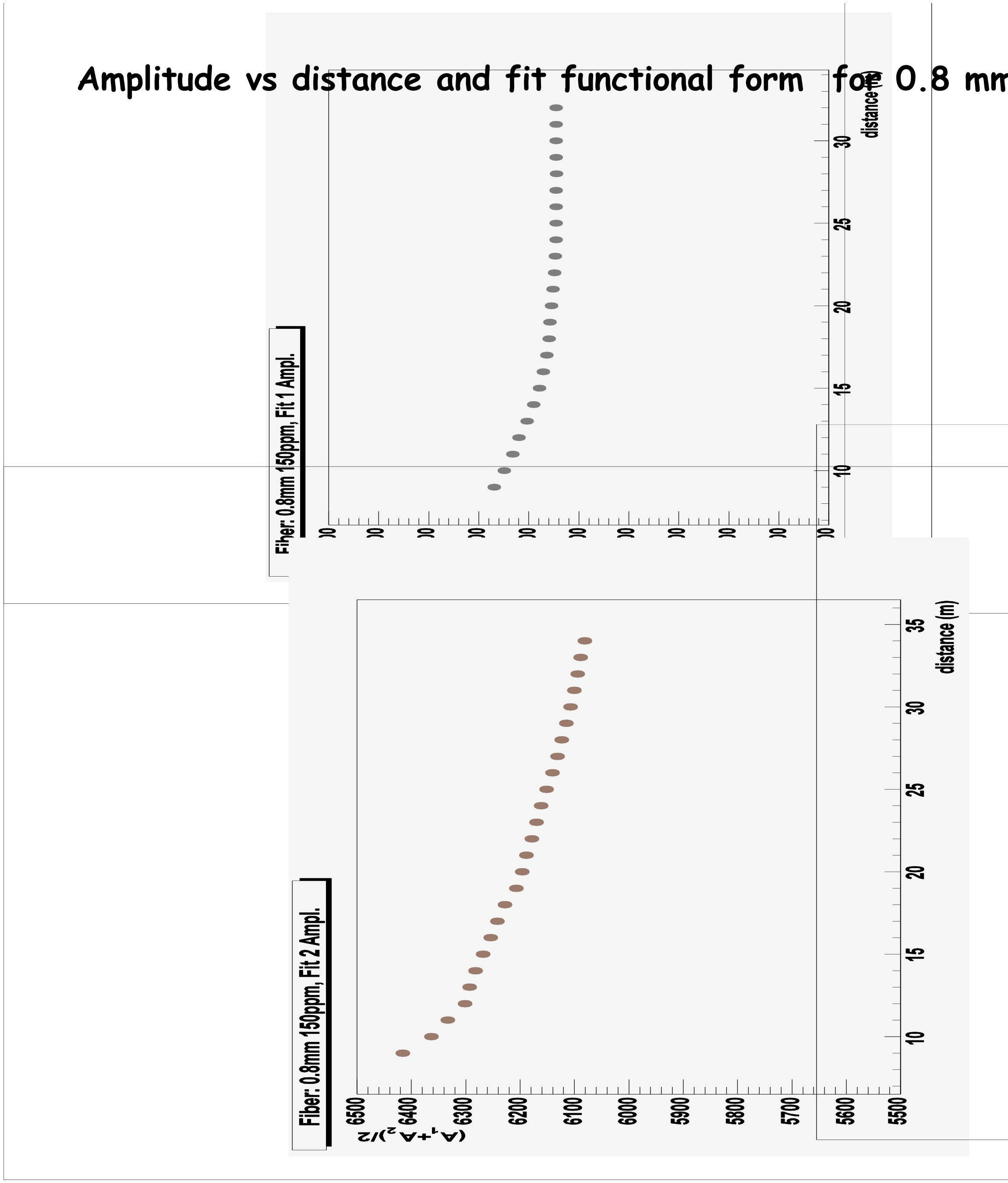


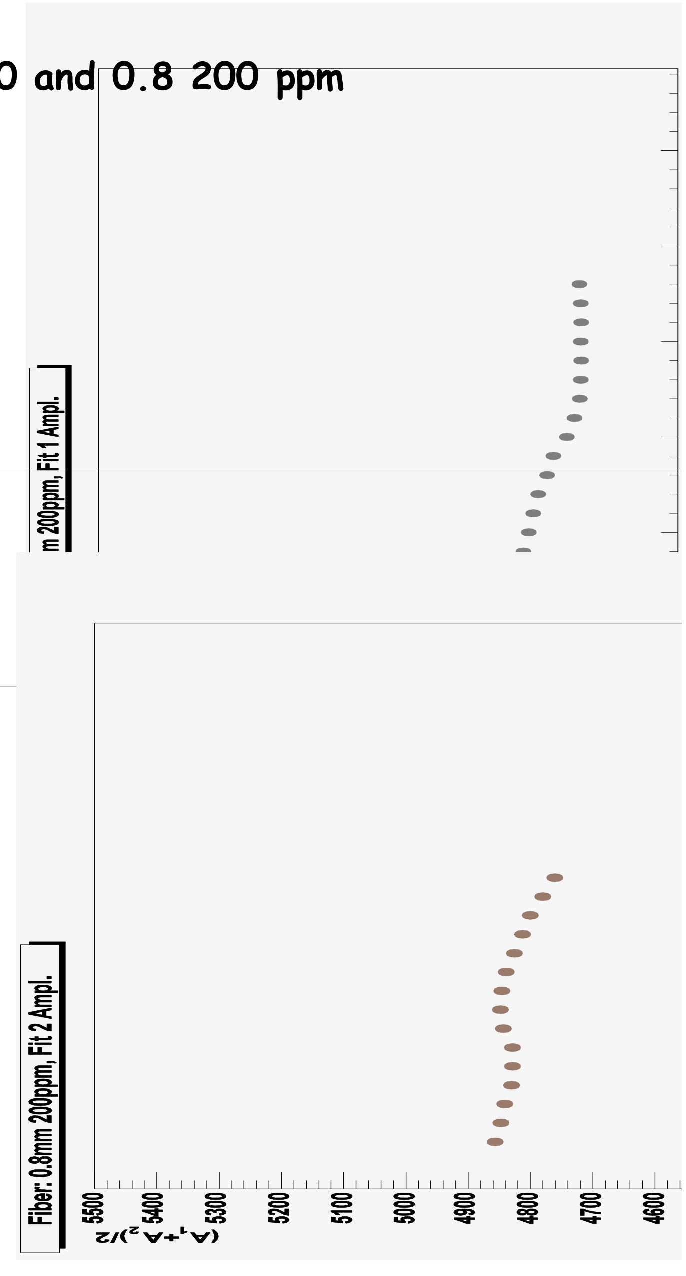




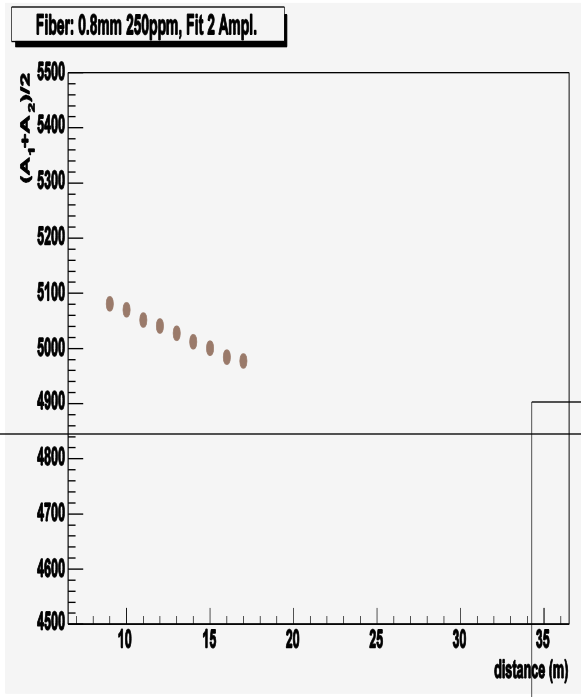


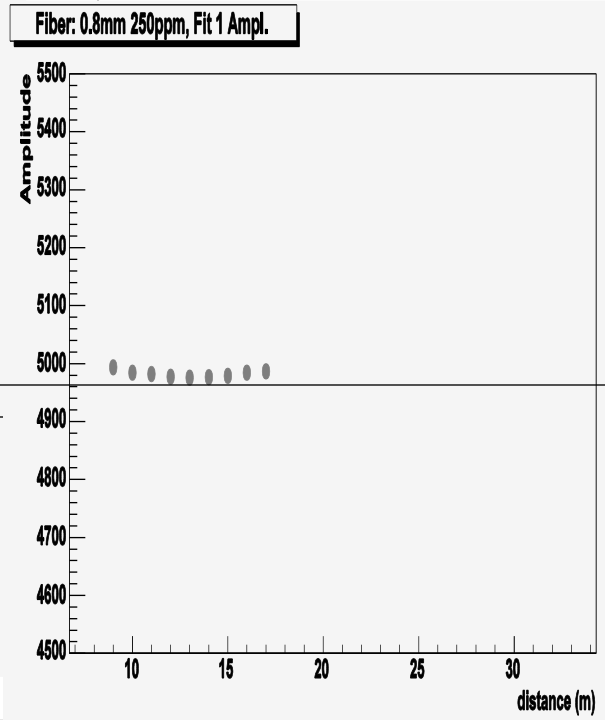
Amplitude vs distance and fit functional form for 0.8 mm 150 and 0.8 200 ppm

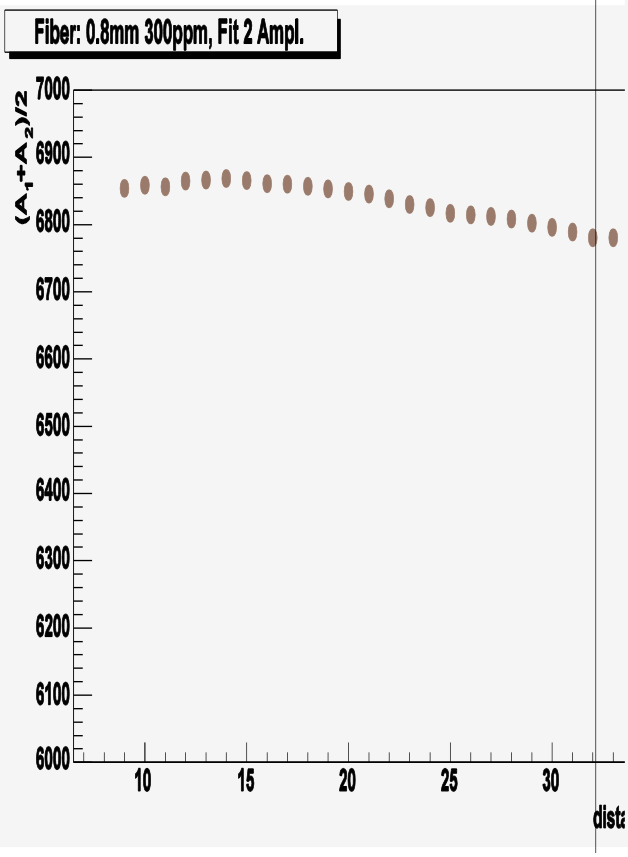


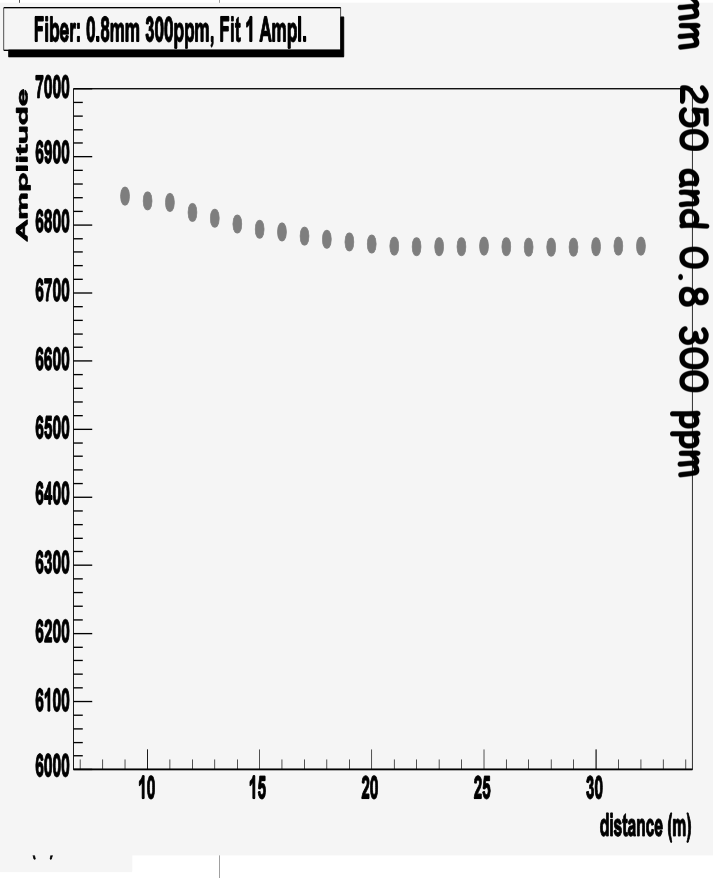


Amplitude vs distance fit functional form for 0.8 mm 250 and 0.8 300 ppm

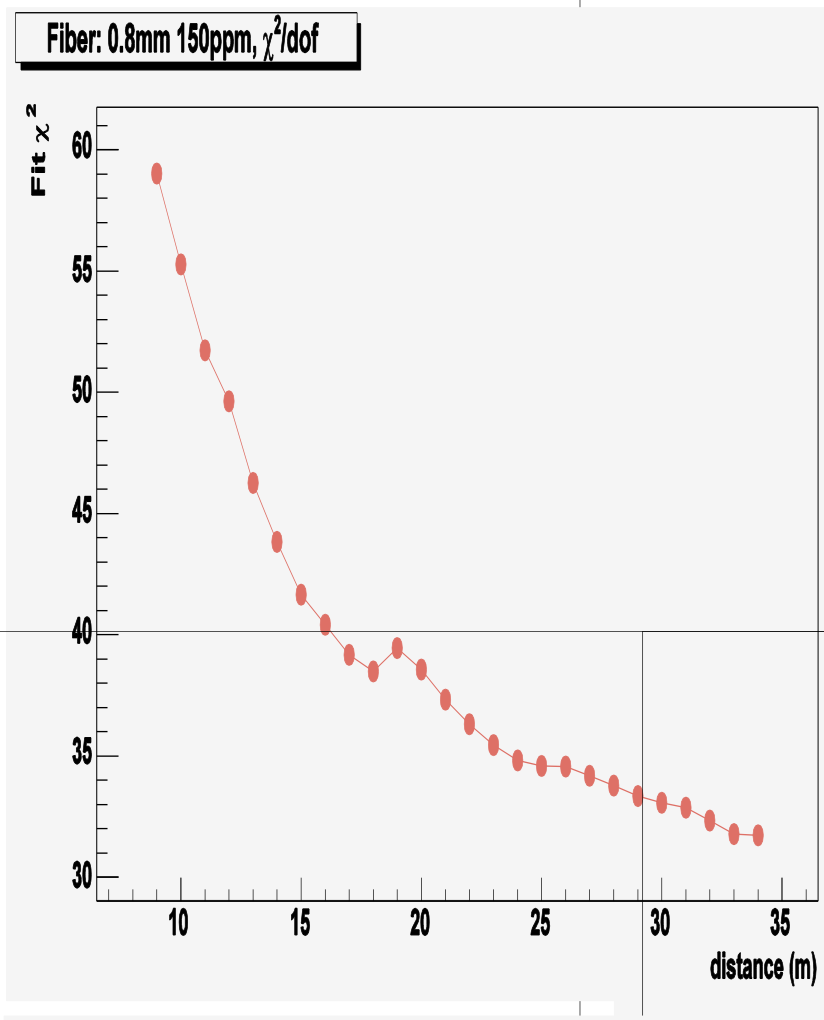


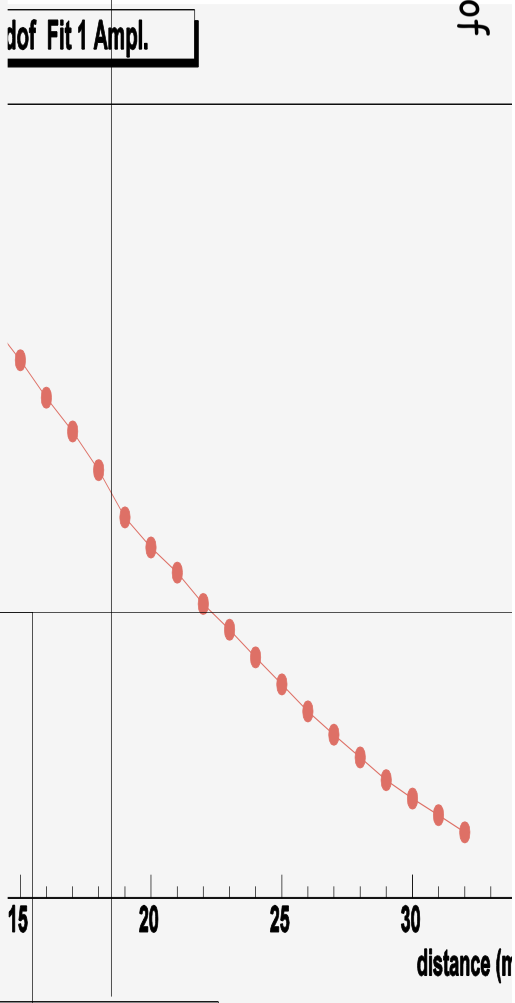


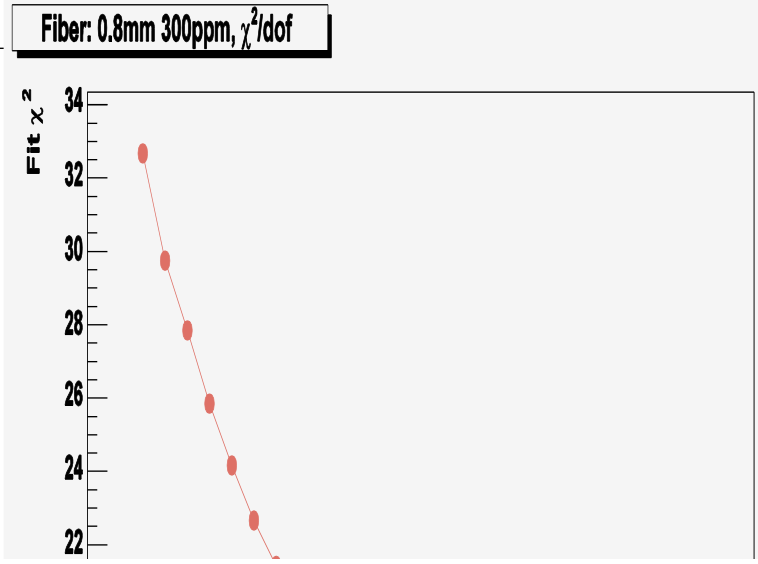


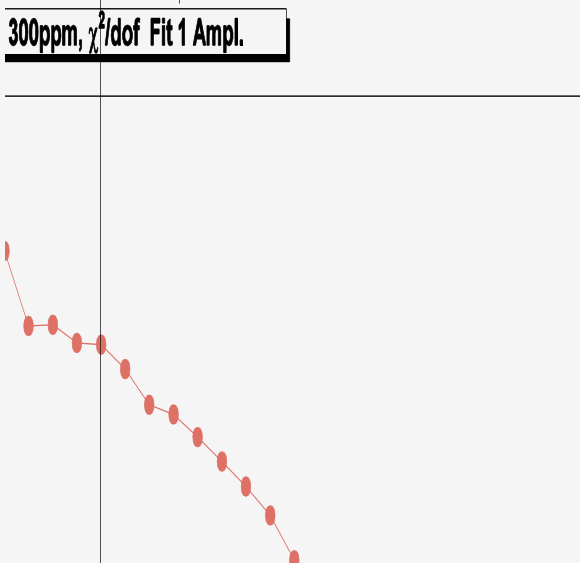


Chi square /dof









Fit , versus die concentration for 0.8 mm diameter fiber

0.8 mm diameter fibers, fit from 0-17 meters Single amplitude fit

ppm	A	λ_1 (m)	λ_2 (m)	χ^2	dof	χ^2/dof
150	6064 ± 4	3033 ± 7	9370 ± 6	9850	156	63
200	4670 ± 4	4071 ± 14	9511 ± 11	4244	105	40
250	4987 ± 3	3060 ± 7	9113 ± 4	5856	172	34
300	6784 ± 4	3297 ± 7	10000 ± 6	3877	149	26

0.8 mm diameter fibers, fit from 0-17 meters Double amplitude fit

ppm	<A>	λ_1 (m)	λ_2 (m)	χ^2	dof	χ^2/dof
150	6242 ± 32	1853 ± 16	8068 ± 15	6073	155	39
200	4859 ± 26	1512 ± 27	7469 ± 12	1733	104	17
250	4978 ± 91	3186 ± 30	9400 ± 70	5836	171	34
300	6860 ± 61	2553 ± 21	8745 ± 26	2920	148	20

Chi Square /dof is very much too greater then unity. Given that the curve reproduce te data this must be an indication that we are underestimating the experimental errors

Comparison with previous results, (single amplitude fit from 0 to 17 meters as in August measurements

	ppm	λ_1 (m)	August results	λ_2 (m)	August results
	150	3033 ± 7	**3.19** ± 0.14 ± ???	9370 ± 6	**8.61** ± 0.08 ± ???
???	200	4071 ± 14		9511 ± 11	
	250	3060 ± 7	**2.58** ± 0.1+/-???	9113 ± 4	**8.44** ± 0.06 ± ???
	300	3297 ± 7		10000 ± 6	

The trend is opposite now ????

λ_1 (m)

	0.6	**0.7**	**0.8**
150		**8.79** ± 0.10 ± ???	**8.61** ± 0.08 ± ???
200			
250			**8.44** ± 0.06 ± ???
300		**8.46** ± 0.11 ± ???	

λ_2 (m)

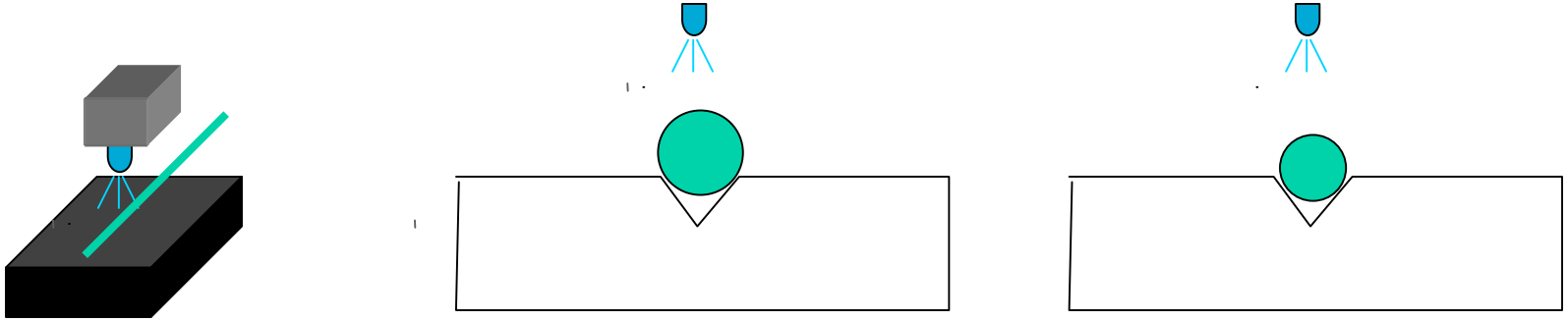
	0.6	**0.7**	**0.8**
150		**3.54** ± 0.14 ± ???	**3.19** ± 0.14 ± ???
200			
250			**2.58** ± 0.1+/-???
300		**2.66** ± 0.06 ±???	

Comparison with 0.6 mm 150 ppm single amplitude fit from 0 to 8.5 m

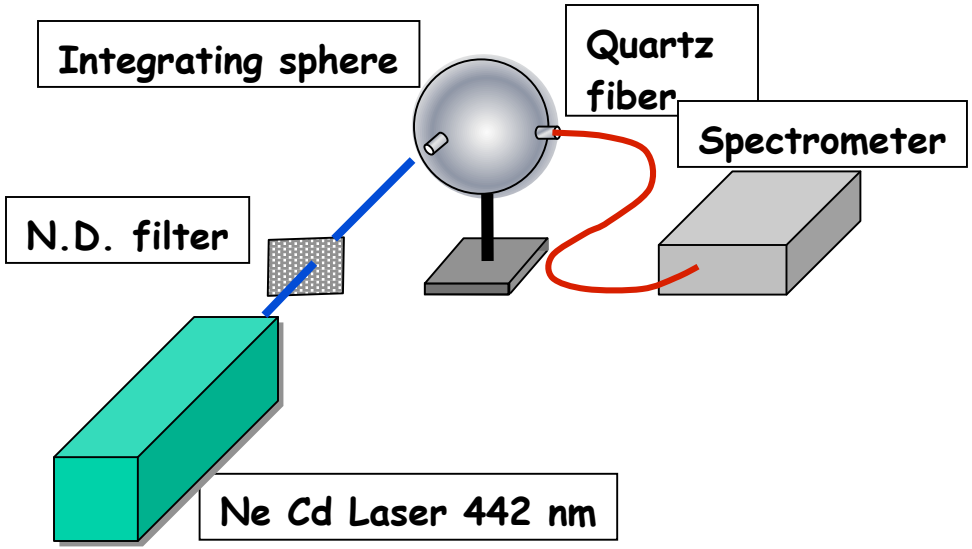
0.8 mm diameter fibers, fit from 0-8.5 meters Single amplitude fit

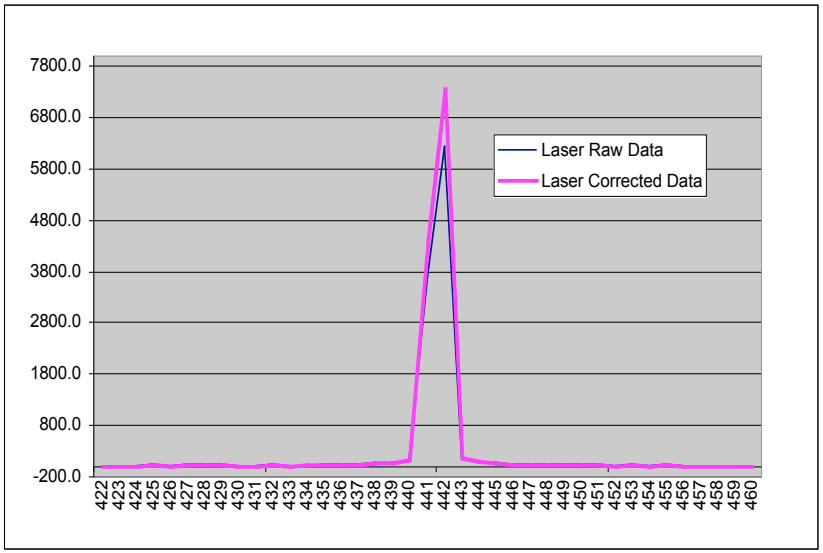
diameter	ppm	A	λ_1 (m)	λ_2 (m)	χ^2	dof	χ^2/dof
0.8	150	**6174 ± 5**	**2614 ± 9**	**10610 ± 19**	6357	77	83
0.6	150	**3114 ± 4**	**1909 ± 9**	**12080 ±24**	4514	83	72

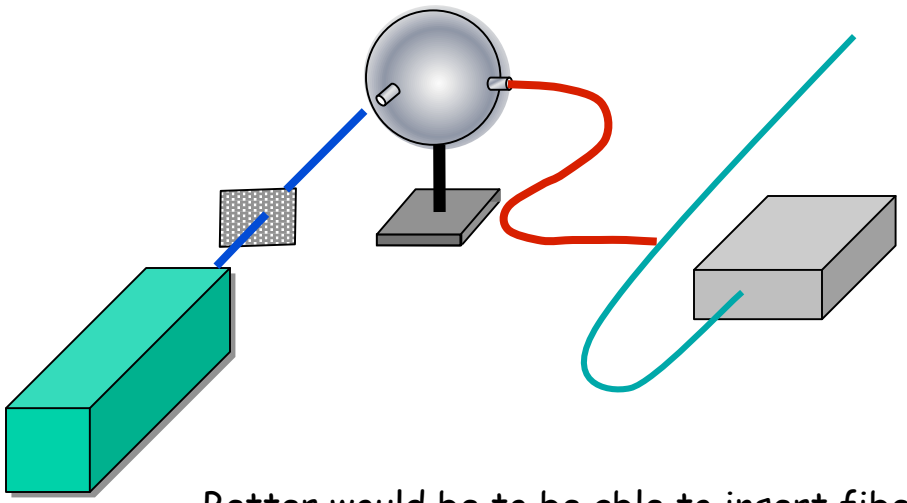
But the two amplitude cannot be directly compared since the distance of the fiber from the light source is not the same due to the difference in fiber diameter

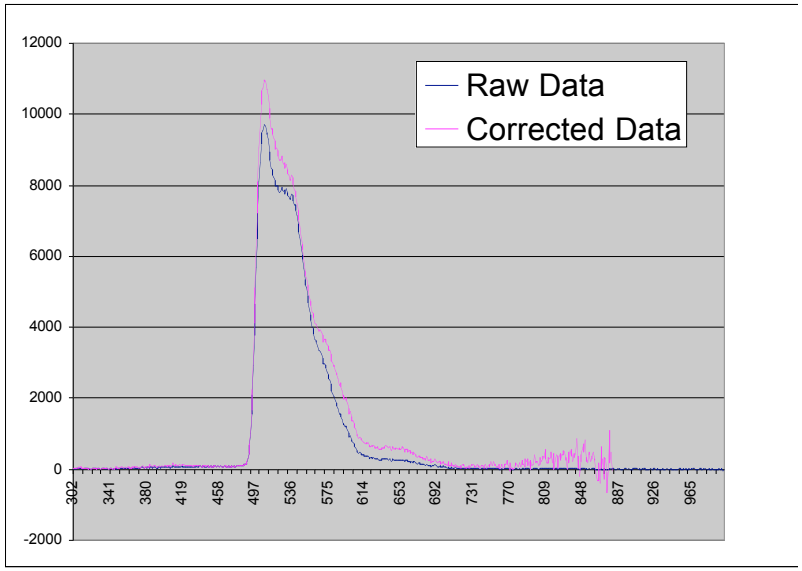


A different approach at CNR Bologna









Better would be to be able to insert fiber inside the sphere

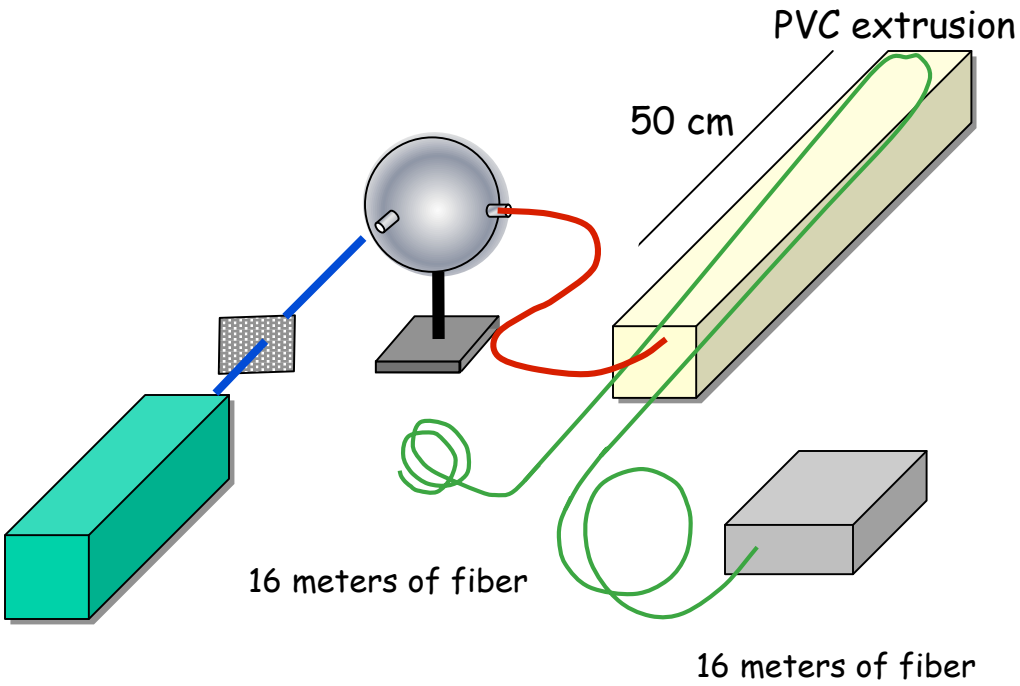
Quartz fibra ottica: length = 2 m
Diameter = 600 micron
attenuation = 30 dB / Km a 442 nm

Sphera
diametro = 4 inchees
reflectance = 0.98 (at 442 nm)

HeCd laser:
power = 36.8 mW (at 441.6 nm)
power stability = 1.5 %
beam diameter = 0.94 mm

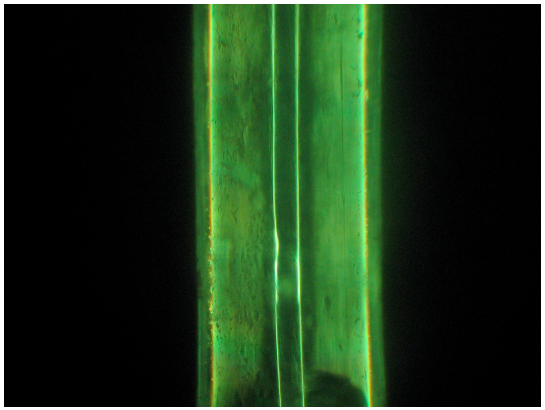
Using a smaller diameter quartz fiber will allow a direct comparison of different diameter fibers

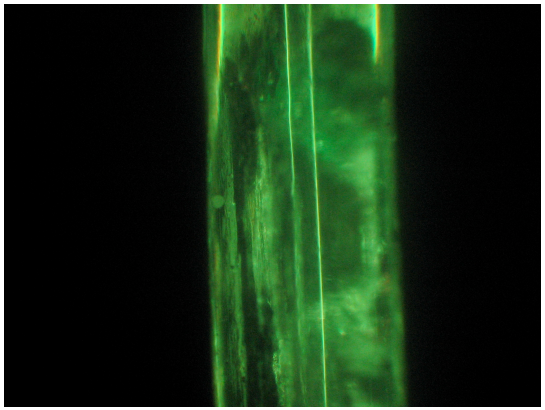
Also :

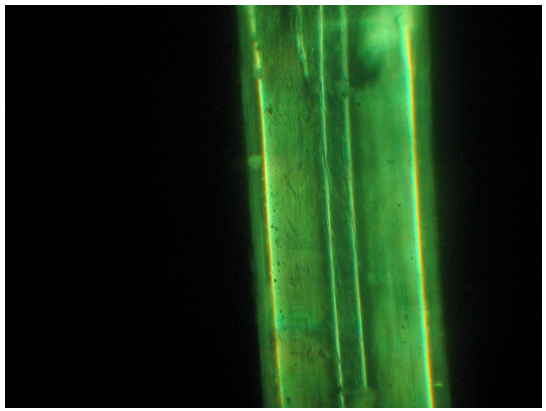


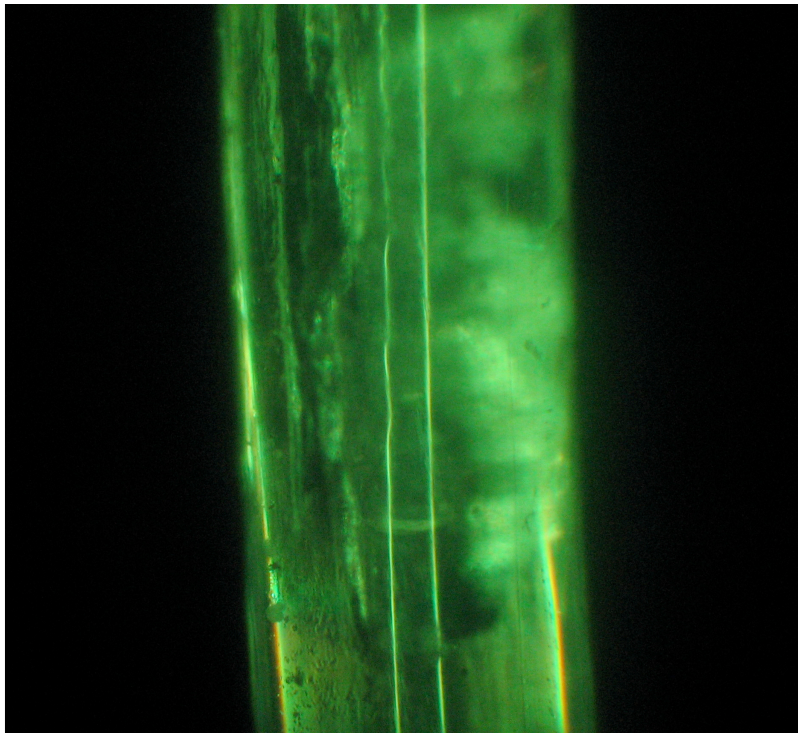
Got some data but still too preliminary

Finally









Pictures made by Stefano Patuelli Dept. of Physics
University of Bologna

18 November 2006

Plan for the immediate future:

- Complete on all the fibers the measurements of attenuation length.
- Measure relative light yeald
- Test fiber response as function of bending radius

Next:

- Start test of fiber survival in pseudocumene
- Start aging test

and …..